

AMENDMENTS TO THE CLAIMS:

This listing of claims will replace all prior versions, and listings, of claims in the application:

LISTING OF CLAIMS:

1. (CURRENTLY AMENDED) A method for measuring a flow rate (v) or a mass flow of a fluid (3), in particular for measuring hot water supply in the private, public or industrial sector, in which the fluid (3) is guided over a sensor element (1), which has a heating means (1a) for inducing temperature changes and a sensor means (1b) for determining its temperature, wherein at least from time to time the heating means (1a) is operated with a heating power (P) in the form of heating pulses and a flow-dependent threshold value time (t_s) is measured at the sensor means (1b) until a preset temperature threshold value (T_s) is reached, ~~characterised in that~~ wherein during at least some of the heating pulses (7) a non-constant heating power (P) with a substantially sublinear build-up dynamics ($P(t)$) as a function of time (t) is selected in order to at least partially compensate a nonlinear behaviour of the threshold value time (t_s) as a function of the flow rate (v).
2. (CURRENTLY AMENDED) The method as claimed in claim 1, ~~characterised in that~~ wherein the build-up dynamics ($P(t)$) as a function of the time (t) and, if required, of the flow rate (v) to be measured is varied itself such that the threshold value time (t_s) is a linear function of the flow rate (v) at least on discrete flow rate values (v_i).
3. (CURRENTLY AMENDED) The method as claimed in any one of the preceding claims, ~~characterised in that~~ wherein the build-up dynamics ($P(t)$) is selected to be proportional to t^m , wherein m =an exponent dependent on a Reynolds number of the fluid (3) which is lower than 1, in particular $m \leq 0.5$ and particularly preferred $m=0.466$ for a Reynolds number of the fluid (3) between 40 and 4000.
4. (CURRENTLY AMENDED) The method as claimed in ~~any one of the preceding~~ any of claims 1 and 2, ~~characterised in that~~ wherein the build-up dynamics ($P(t)$) is selected to be proportional to a time-independent amplitude factor $(1+R_s/R_l)^{-1}$, wherein

R_s is a first thermal transfer resistance between the heating means (1a) and a surface (10) of the sensor element (1) and $R_l=(h \cdot A)^{-1}$ is a second thermal transfer resistance between the surface (10) of the sensor element (1) and the fluid (3), wherein h is a flow-dependent heat transfer coefficient between the sensor element (1) and the fluid (3) and A is a contact surface between the sensor element (1) and the fluid (3).

5. (CURRENTLY AMENDED) The method as claimed in claims 3 and 4, characterised ~~in that~~ wherein a cylindrical sensor element (1), against which the fluid (3) is transversely flown, is selected with a heat transfer coefficient h proportional to v^m and with a second thermal transfer resistance $R_l=\gamma \cdot v^{-m}$, γ being a constant.
6. (CURRENTLY AMENDED) The method as claimed in claims 3 and 4, characterised ~~in that~~ wherein
 - a) in a first step discrete values of the flow rate (v_i) are selected and corresponding build-up dynamics $P_i(t)$ of the heating power are determined, wherein $i=1, 2, 3, \dots$ is an index,
 - b) in a second step a set of calibration curves (8) of the threshold value time (t_s) as a function of the flow rate (v) is determined for the build-up dynamics ($P_i(t)$) and
 - c) in a third step, on account of a previously measured flow rate or based on a-priori information about the presumed flow rate, a preferred calibration curve (8) is selected according to a desired measuring precision for the flow rate (v) and according to a desired measuring duration (t_s), and is used to determine the flow rate (v), or
 - d) in a third step, starting from the calibration curve (8) associated with the lowest flow rate value ($v_{i=1}$) and rising successively to higher flow rate values ($v_{i>1}$) or by estimating in a single step, a preferred calibration curve (8) is determined according to a desired measuring precision for the flow rate (v) and according to a desired measuring duration (t_s), and is used to determine the flow rate (v).
7. (CURRENTLY AMENDED) The method as claimed in claim 6, ~~characterised in that~~ wherein a number and distribution of the calibration curves (8) are selected according

to a desired measuring resolution and to a desired measuring range of the flow rate (v).

8. (CURRENTLY AMENDED) The method as claimed in claims 3 and 4, ~~characterised in that~~ wherein $R_s/R_l < 1$, preferably $R_s/R_l < 0.1$ and particularly preferred $R_s/R_l < 0.01$, and a heating power factor P_0 are selected and the threshold value time (t_s) is calculated as an exact linear function of the flow rate (v) according to an equation

$$t_s(v) = (T_s - T_F)^{1/m} \cdot (P_0 \cdot \gamma)^{-1/m} \cdot v,$$

wherein γ is a constant and T_F is an undisturbed fluid temperature.

9. (CURRENTLY AMENDED) A device for carrying out the method as claimed in claim 6 ~~any one of the preceding claims~~, comprising a sensor element (1) with a heating means (1a) and a sensor means (1b) for thermal measuring in a fluid (3) and a control and evaluating processor unit (2) with a heating control (2a) for generating heating pulses (7) for the heating means (1a) and a measuring device (2b) for evaluating the thermal measurement and for determining a flow rate (v) or a mass flow from a flow-dependent threshold value time (t) until a preset temperature threshold value (T_s) at the sensor means (1b) is reached, ~~characterised in that~~ wherein

- a) the heating control (2b) comprises means for generating a non-constant heating power (P) with a substantially sublinear build-up dynamics ($P(t)$) as a function of the time (t), and
- b) the control and evaluating processor unit (2) has means for at least partial compensation of a nonlinear behaviour of the threshold value time (t_s) as a function of the flow rate (v).

10. (CURRENTLY AMENDED) The device as claimed in claim 9, ~~characterised in that~~ wherein

- a) the control and evaluating processor unit (2) comprises hardware and/or software for generating a build-up dynamics ($P(t)$) proportional to t^m and/or to

a time-independent amplitude factor $(1+R_s/R_l)^{-1}$, wherein t is a time variable, m is an exponent dependent on a Reynolds number of the fluid-(3), R_s is a first thermal transfer resistance between the heating means (1b) and a surface (1a) of the sensor element-(1), $R_l=(h \cdot A)^{-1}$ is a second thermal transfer resistance between a surface (10) of the sensor element (1) and the fluid-(3), h is a flow-dependent heat transfer coefficient between the sensor element-(1) and the fluid (3) and A is a contact surface between the sensor element (1) and the fluid (3) is and/or

- b) the control and evaluating processor unit (2) comprises calibration means (2e) for carrying out the first and second step ~~as claimed in Claim 6.~~

11. (CURRENTLY AMENDED) The device as claimed ~~in any one of claims 9 to 10,~~
characterized in that claim 9, wherein:

- a) the sensor element (1) has an electric heating wire (1a, 1b) with a temperature-dependent resistance, which can be operated simultaneously as heating means (1a) and as sensor means (1b) and/or
- b) the sensor element (1) has a heat capacity C_s and a first thermal transfer resistance R_s between the heating means (1b) and a surface (10) of the sensor element-(1), wherein the threshold value time or measuring duration is $t_s > C_s \cdot R_s$, in particular $t_s > 10 \cdot C_s \cdot R_s$, and/or
- c) the sensor element (1) has a cylindrical shape with a diameter (d) and which has, when the fluid (3) flows laterally against it with the flow rate (v), has by approximation a flow-dependent heat transfer coefficient $h = \lambda/d \cdot 1.11 \cdot C \cdot Pr^{0.31} \cdot Re^m$, wherein λ is a heat conductivity of the fluid-(3), C is a parameter and m is an exponent, which depend on a Reynolds number Re of the fluid-(3), and Pr is a Prandtl number of the fluid-(3).

12. (NEW) The method as claimed in claim 4, wherein a cylindrical sensor element, against which the fluid is transversely flown, is selected with a heat transfer coefficient h proportional to v^m and with a second thermal transfer resistance $R_1 = \gamma \cdot v^{-m}$, γ being a constant.

13. (NEW) The method as claimed in claim 4, wherein

- a) in a first step discrete values of the flow rate (v_i) are selected and corresponding build-up dynamics $P_i(t)$ of the heating power are determined, wherein $i=1, 2, 3, \dots$ is an index,
- b) in a second step a set of calibration curves of the threshold value time (t_s) as a function of the flow rate (v) is determined for the build-up dynamics ($P_i(t)$) and
- c) in a third step, on account of a previously measured flow rate or based on a-priori information about the presumed flow rate, a preferred calibration curve is selected according to a desired measuring precision for the flow rate (v) and according to a desired measuring duration (t_s), and is used to determine the flow rate (v), or
- d) in a third step, starting from the calibration curve associated with the lowest flow rate value ($v_{i=1}$) and rising successively to higher flow rate values ($v_{i>1}$) or by estimating in a single step, a preferred calibration curve is determined according to a desired measuring precision for the flow rate (v) and according to a desired measuring duration (t_s), and is used to determine the flow rate (v).

14. (NEW) The method as claimed in claim 13, wherein a number and distribution of the calibration curves are selected according to a desired measuring resolution and to a desired measuring range of the flow rate (v).

15. (NEW) The method as claimed in claim 4, wherein $R_s/R_1 < 1$, preferably $R_s/R_1 < 0.1$ and particularly preferred $R_s/R_1 < 0.01$, and a heating power factor P_0 are selected and the threshold value time (t_s) is calculated as an exact linear function of the flow rate (v) according to an equation

$$t_s(v) = (T_s - T_F)^{1/m} \cdot (P_0 \cdot \gamma)^{-1/m} \cdot v,$$

wherein γ is a constant and T_F is an undisturbed fluid temperature.